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# INSECT ASSOCIATES OF SPURGES, MAINLY *EUPHORBIA MACULATA* L., IN EASTERN UNITED STATES

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*Abstract.*—The insect fauna associated with mats of a prostrate spurge, *Euphorbia maculata* L., was studied in Pennsylvania and North Carolina during 1979–80. All species observed (except pollinators and foragers at nectariferous glands) are listed, and notes on feeding habits, phenology, and previously recorded associations with *Euphorbia* are given for the more common species. A sap-feeding guild, including several specialists on Euphorbiaceae, dominated the fauna. Coreid, rhopalid, and mirid bugs fed exclusively on flowers and fruits; several lygaeids fed on fallen seeds. A few species are recorded from *E. dentata* Michx. and *E. preslii* Guss. in Pennsylvania, *E. blodgettii* Engelm. ex Hitchc. in Florida, and *E. maculata* in New York, West Virginia, and Georgia. Mats of *E. maculata* generally harbored a more diverse fauna than the erect *Euphorbia* spp.

The genus *Euphorbia* L., containing an estimated 1600 species of herbs, shrubs, and trees in subtropical and temperate regions, is not only the largest genus of the spurge family Euphorbiaceae but one of the most broadly interpreted of modern plant genera (Richardson, 1968). Interest in these plants is keen owing to their poisonous properties (Kingsbury, 1964), ornamental uses, and importance as agricultural weeds (Krochmal, 1952). Several introduced spurges have adversely affected North American agriculture; cypress spurge, *Euphorbia cyparissias* L., and especially leafy spurge, *E. esula* L., have had the greatest impact. The latter species, a noxious perennial first introduced to the United States in the early 19th century (Britton, 1921), has infested some 2.5 million acres of cultivated land in the western states (Noble et al., 1979).

Biological control workers have surveyed the arthropod fauna of *Euphorbia* in Europe (Schröder, 1970) and have imported and released lepidopteran species (Sesiidae, Sphingidae) in an attempt to reduce infestations of *E. esula* (Carl and Zwölfer, 1965; Harris, 1970; New, 1971; Forwood and McCarty, 1980). Several species of Coleoptera are under evaluation for

potential release (Harris, 1979). Although entomologists logically have focused on Old World insects restricted to *Euphorbia*, a better understanding of arthropod communities associated with native and naturalized spurges is desirable. Selleck (1959) and Maw (unpublished, cited in Best et al., 1980) have recorded the fauna, largely species attracted to nectar and pollen, associated with the introduced *E. esula* in Saskatchewan. The literature treating native *Euphorbia*–insect relationships consists of observations on visitors to mats of the western *E. albomarginata* Torrey and Gray (Krombein, 1961), pollination studies on this and two other western spurges (Ehrenfeld, 1979), and casual references to individual species, e.g., Cockerell (1911).

The principal native host observed in my study was *E. maculata* L., a usually prostrate annual often referred to as *E. supina* Raf.; for a history of the taxonomic confusion and correct nomenclature, see Wheeler (1939, 1960), Croizat (1962), and Burch (1966). This small-leaved, hispid-villous plant, generally distributed throughout eastern United States and southern Canada, ranges west to North Dakota and Texas; it is thought to have been introduced to Oregon, California, and Arizona (Wheeler, 1941). *Euphorbia maculata* belongs to the subgenus *Chamaesyce* whose species are less important as agricultural pests than those of the subgenus *Esula*, which contains cypress and leafy spurge (Wheeler, 1941). It is an occasional weed in home lawns and becomes a major pest only in localized areas, e.g., western New York's onion-growing region (Dunn, 1979).

I made limited observations on the insect associates of toothed spurge, *E. dentata* Michx.; on an erect plant, here called *E. preslii* Guss.; and on the prostrate *E. blodgettii* Engelm. ex Hitchc. The correct name for *preslii* has been in question, and the names *hypericifolia* L., *nutans* Lag., and *maculata* L. (sensu Wheeler, 1939) have been used (Burch, 1966; Richardson, 1968).

## Study Sites and Methods

The main study sites in Pennsylvania were railroad yards at Enola (Cumberland Co.) and Harrisburg (Dauphin Co.), and railroad tracks at Hershey (Dauphin Co.) where mats of *E. maculata* were growing in ballast material. A fourth site was a small garden near Matthews (Mecklenburg Co.), North Carolina. The prostrate growth habit of *E. maculata* made direct observation and a "scratch and search" technique (Slater and Baranowski, 1978) efficient means of studying the associated fauna. Insects were hand picked from the plants or from beneath mats. Live specimens of common species were observed in the laboratory to determine feeding sites and possible host injury. Because *E. maculata* is a relatively late-season annual, appearing about 1 June in the Harrisburg area, I did not begin sampling until mats were established. During September–November 1979 and July–October

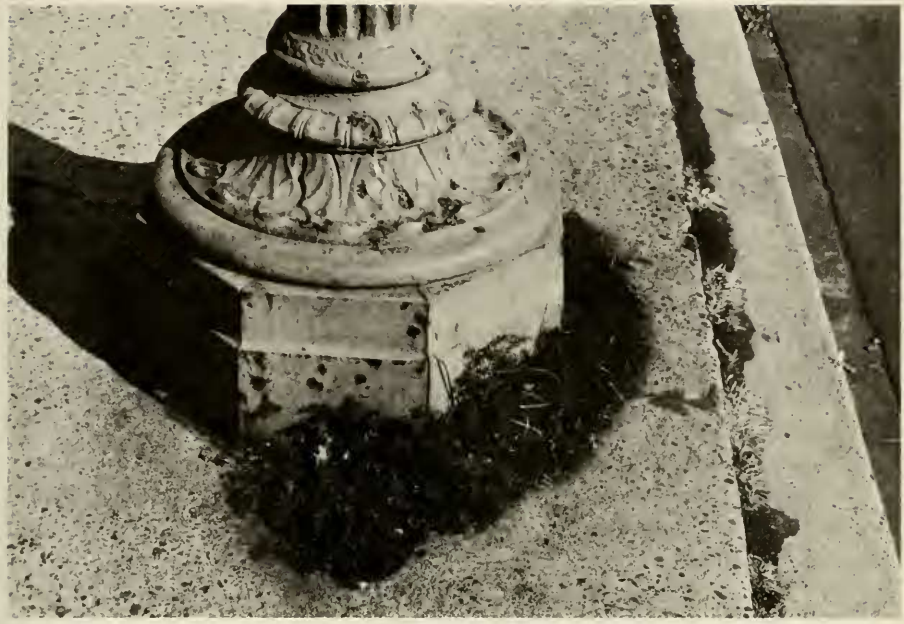

Fig. 1. Mat of *Euphorbia maculata* growing along a city sidewalk.

1980, I made 15 collections at the four main sites (Hershey—5 samples, Enola—3, and Harrisburg, Pa.—2; Matthews, N.C.—5).

I made ten supplemental observations on *E. maculata* growing at the edge or in cracks of sidewalks and paving (Fig. 1) in the Harrisburg area and took five samples from *E. preslii* and one from *E. dentata*. Single collections were made from *E. maculata* at Ithaca, N.Y.; Grafton, W. Va.; Monroe, N.C.; and Atlanta, Ga. Collections from mats of *E. blodgettii* were made in Dade Co. and Big Pine Key (Monroe Co.), Fla. Voucher specimens have been deposited in the insect collection of the Bureau of Plant Industry, Pa. Dep. Agric., Harrisburg.

## Results

In Table 1 relative abundance, stages collected, feeding habits, and collection sites are given for the insect community associated with mats of *E. maculata* and the species collected from *E. blodgettii*, *E. dentata*, and *E. preslii*. Habits and seasonality are provided for the more common species; for these, or related species, previously recorded associations with *Euphorbia* are cited.

### Hemiptera-Heteroptera

Thyreocoridae.—Little biological data are available for members of the taxonomically difficult genus *Galgupha*, negro bugs belonging to a group

one hemipterist has labeled "small, miserable black insects" (Leston, 1961). In the railroad yards at Harrisburg the uniformly black adults of *G. aterrima* McAtee and Malloch were found beneath mats of *E. maculata* where they were difficult to distinguish from cinders of ballast material near the tracks. Nymphs occurred during September on the inflorescences and developing capsules, and in the laboratory they fed exclusively on these reproductive structures. I found that *G. atra* Amyot and Serville had similar habits in North Carolina, and I collected this species on *E. maculata* at Atlanta, Ga.

Thyreocorids were among the most abundant hemipterans associated with *Euphorbia* plants in Arizona (Ehrenfeld, 1979). Hoffman (1975) noted that *Galgupha* spp. occurring in the eastern U.S. are more often encountered on the ground or under cover than in sweeping vegetation. It seems likely that careful study will show that *Galgupha* spp. consistently are associated with reproductive structures of prostrate spurges.

Coreidae.—*Chariesterus antennator* (F.), belonging to a New World genus found mainly in subtropical and tropical regions, is restricted to the Euphorbiaceae. Related species of *Chariesterus* are intimately tied to this plant family; they serve as intermediate vectors of dermatitis-transmitting flagellate protozoans living in the latex of *Euphorbia* spp. (Strong, 1924).

Although no detailed life history study exists for *C. antennator*, this specialist herbivore has been collected on *E. corollata* L. (Hussey, 1922) and *E. preslii* (=*nutans*) (Osborn, 1904a). In Missouri, Sullivan (personal communication) observed nymphs on fruiting plants of *E. dentata* and *E. preslii* and mating pairs on *E. corollata*. I found this characteristic *Euphorbia* associate only in small numbers on *E. preslii* in Pennsylvania. This coreid becomes more common in the southeastern states (Slater and Baranowski, 1978), and in the Florida Keys I observed a large population breeding on the prostrate *E. blodgettii*.

Rhopalidae.—*Liorhyssus hyalinus* (F.), known from *E. preslii* (Osborn, 1904a), also feeds on plants of unrelated families (Southwood and Leston, 1959). This rhopalid was, however, a characteristic *Euphorbia* associate in Pennsylvania where two and possibly three generations developed on *E. maculata* from July through October. Eggs were placed in clusters of 25–30 on lower leaf surfaces; nymphs fed only on the flowers and developing fruits. As noted by Osborn (1904b), nymphs blend in well with the color of the host plant. Adults were present on mats of *E. maculata* until late October in Pennsylvania and were collected on this plant in Georgia during early December.

Lygaeidae.—This largely seed-feeding family contributed nine species to the *Euphorbia*-insect community; at least six species occurred consistently among fallen seeds under mats of *E. maculata*. The orsilline *Nysius niger* Baker (=*ericae* (Schilling) of American authors (Ashlock, 1977)) developed

the largest populations. Milliken (1918) noted that this lygaeid placed some of its eggs in the clustered parts of *E. serpyllifolia* Pers. Other *Nysius* spp., e.g., *N. coenosulus* Stål in Hawaii (Zimmerman, 1948), have been recorded from *Euphorbia,* and *N. euphorbiae* Horvath transmits a protozoan from the latex of one plant to another (Lafont, 1910).

Adults and nymphs of the myodochines, *Neopamera bilobata* (Say) and *Ptochiomera nodosa* Say, also occurred in large numbers, especially on mats growing under harsh conditions such as cracks in sidewalks, parking lots, and other paved areas. Sweet (1960) noted that these species were typical of ruderal sites having sparse vegetation. Watson (1917) observed that the strawberry pest *Pseudopachybrachius vinctus* (Say) (cited as *Pamera vincta*) is "very abundant" on its possible native host, wild spurge; his observations may, in fact, refer also to *N. bilobata* (Sweet, 1960). *Ligyrocoris diffusus* Uhler and *Myodochus serripes* Olivier were common but were more apt to be associated with mats growing in less harsh environments like gardens or edges of lawns. Although these orsilline and myodochine lygaeids might use prostrate spurges only as hiding places, their consistent collection under mats, often in assemblages of three or four species, coupled with my observations of seed feeding in the laboratory, suggest that seeds of *E. maculata* may be among their preferred foods. It is significant that M. H. Sweet, who has provided the most detailed information on seed-feeding habits in the Lygaeidae (Sweet, 1964), also has noted the presence of lygaeids under prostrate species of *Euphorbia* (personal communication).

The geocorine lygaeids found under *E. maculata,* mainly *Geocoris uliginosus* Say, may prey on other lygaeids inhabiting the litter layer. Sweet (1964) observed *uliginosus* feeding on *Ptochiomera nodosa,* and Crocker and Whitcomb (1980) reported *G. bullatus* (Say) preying on *Neopamera bilobata* (cited as *Pachybrachius bilobatus*); I found both prey lygaeids commonly under spurges. Geocorines also feed on plant material, including seeds (Sweet, 1960; Tamaki and Weeks, 1972), and may feed on fallen seeds of prostrate euphorbias.

Miridae.—*Semium hirtum* Reuter, first associated with spurges by Heidemann (1901), belongs to a genus known only from *Euphorbia* (Kelton, 1973). This specialist appears restricted to the prostrate spurges where it feeds on developing inflorescences. Osborn (1904b) noted that the appearance of this mirid in Ohio coincided with the development of blossoms on its host (a weedy *Euphorbia* common on the Ohio State University campus, probably *E. maculata*). The pinkish-rose nymphs and adults of contrasting rosy red, black, and white are well camouflaged on their hosts. In Pennsylvania nymphs were found from July to early November; the recurrence of early instars in September indicates the beginning of a possible second generation. In North Carolina adults were present until late November.

Table 1. Arthropod fauna associated with *Euphorbia maculata* and *E. preslii*.[a]

| | Relative Freq. on | | Stages | Feeding Sites, Habits | Collection Sites |
|---|---|---|---|---|---|
| | *E. m.* | *E. p.* | | | |
| HEMIPTERA-HETEROPTERA | | | | | |
| Cydnidae | | | | | |
| *Melanaethus pensylvanicus* (Signoret) | R | — | N,A | R? | 2 |
| Thyreocoridae | | | | | |
| *Galgupha aterrima* Malloch | C | R | N,A | F | 1,2 |
| *Galgupha atra* Amyot and Serville | M | — | A | F | 4,5 |
| Pentatomidae | | | | | |
| *Thyanta* sp. | R | — | N | F | 2 |
| Coreidae | | | | | |
| *Chariesterus antennator* (F.) | C | — | N,A | F | 2,6[b] |
| Rhopalidae | | | | | |
| *Liorhyssus hyalinus* (F.) | C | R | E,N,A | F | 2,5 |
| *Niesthrea sidae* F. | R | — | A | F | 6[b] |
| Lygaeidae | | | | | |
| *Atrazonotus umbrosus* Distant | M | — | A | S? | 2,4 |
| *Geocoris bullatus* (Say) | R | — | A | Pr,S? | 6 |
| *Geocoris uliginosus* (Say) | C | — | N,A | Pr,S? | 2,4,5,6[b] |
| *Ligyrocoris diffusus* Uhler | C | — | N,A | S | 1,2 |
| *Lygaeus kalmii* Stål | M | — | N,A | F | 2,3 |
| *Myodocha serripes* Olivier | C | — | N,A | S | 1,2,4 |
| *Nysius niger* Baker | C | — | N,A | S | 2,6[b] |
| *Neopamera bilobata* (Say) | C | — | N,A | S | 4,5,6[b] |
| *Ptochiomera nodosa* Say | C | — | N,A | S | 2,4,6[b] |
| Nabidae | | | | | |
| *Pagasa fusca* Stein | R | — | A | Pr | 2 |
| *Reduviolus americoferus* (Carayon) | R | — | N,A | Pr | 2 |
| Miridae | | | | | |
| *Semium hirtum* Reuter | C | — | N,A | F | 2,3,4,6[b] |
| *Spanagonicus albofasciatus* Reuter | M | — | N,A | F,L? | 2,4 |
| HEMIPTERA-HOMOPTERA | | | | | |
| Aleyrodidae | | | | | |
| *Trialeurodes abutilonea* (Haldeman) | M | M | P,A | L | 2 |
| *T. vaporariorum* Westwood | R | — | P,A | L | 2 |
| Aphididae | | | | | |
| *Aphis craccivora* Koch | M | M | N,A | L | 2 |
| Cicadellidae | | | | | |
| *Xerophloea viridis* (F.) | M | — | N,A | L? | 4 |
| COLEOPTERA | | | | | |

Table 1. Continued.

| | Relative Freq. on | | Stages | Feeding Sites, Habits | Collection Sites |
|---|---|---|---|---|---|
| | *E. m.* | *E. p.* | | | |
| Chrysomelidae | | | | | |
| *Glyptina spuria* LeConte | C | R | A | R?,L | 2,4,6[b] |
| LEPIDOPTERA | | | | | |
| Yponomeutidae | | | | | |
| *Atteva punctella* Cramer | — | R[c] | P | L | 2 |

[a] Relative frequency: C, consistently collected at most sites, usually >5 specimens; M, moderate abundance, 2–5 sites; R, rare, <2 sites; —, not collected. Stages collected: E, eggs; L, larvae; N, nymphs; P, pupae; A, adults. Feeding sites and habits: F, flowers, fruits; L, leaves, stems; Pr, predacious; R, roots; S, seeds (fallen). Collection sites: 1, N.Y.; 2, Pa.; 3, W. Va.; 4, N.C.; 5, Ga.; 6, Fla.

[b] Host plant is *Euphorbia blodgettii*.

[c] Host plant is *Euphorbia dentata*.

## Coleoptera

Chrysomelidae.—The only coleopteran species I consistently collected from spurges was *Glyptina spuria* LeConte, a little-studied alticine chrysomelid. I found adults of this flea beetle on or under prostrate spurges from Pennsylvania to Florida. In the laboratory adults fed on stems and fruit, pausing occasionally to clean milky sap or latex from their mouthparts. Balsbaugh and Hays (1972), in reporting *G. spuria* from roadside vegetation, noted that specific hosts were unknown; *G. cyanipennis* Crotch, however, feeds on *E. cyathophora* in Florida (Schwarz, 1890). Although I did not find larvae of *G. spuria*, they most likely are root feeders on euphorbias. Larvae of several species of *Aphthona*, a genus closely related to *Glyptina* and tied to plants of the Euphorbiaceae (Blake, 1964), feed on *Euphorbia* roots (Harris, 1979).

## Discussion

Plants of the genus *Euphorbia*, probably owing to the presence of toxic alkaloids, at times have been mentioned as unattractive to insects: "Ordinarily not even grasshoppers will eat these plants" (Wheeler, 1941). But as biological control workers have discovered, spurges harbor a diverse arthropod fauna (Harris, 1979) that includes numerous pollinators (Bakke, 1936; Selleck, 1959; Best et al., 1980). Apparently, however, all parts of spurge plants may be attacked, and several specialist insects appear to have co-evolved with their *Euphorbia* hosts.

Dominant in the present study were members of a sap-feeding guild, es-

pecially species of Hemiptera-Heteroptera. In England, Butler (1918) observed that spurges serve as hosts for several heteropterans. I found that the coreid *Chariesterus antennator* and the mirid *Semium hirtum* were specialist herbivores restricted to the inflorescences and developing fruits, thus occupying a niche used by the so-called spurge bugs of the mainly Old World family Stenocephalidae (Scudder, 1957). The rhopalid *Liorhyssus hyalinus*, although not restricted to spurge, was a characteristic member of the *Euphorbia* community. In general, a more diverse heteropteran fauna developed on prostrate spurges. Mats of *E. maculata*, in addition to harboring larger populations of coreids, mirids, and rhopalids, provided an abundant source of fallen seeds and a presumably favorable microhabitat for various seed-feeding Lygaeidae.

The Hemiptera-Homoptera contributed few species to the *Euphorbia*-insect community and seldom were found in large numbers. I made only two collections of the whiteflies *Trialeurodes abutilonea* Haldeman and *T. vaporariorum* (Westwood), although both are known to occur on *Euphorbia* spp. (Russell, 1963). Cowpea aphid, *Aphis craccivora* Koch, was most common on *E. preslii*. This apparently is the first *Euphorbia* host record for this polyphagous aphid.

Chewing arthropods were scarce; only the chrysomelid *Glyptina spuria* was encountered at several localities. The ailanthus webworm, *Atteva punctella* (Cramer), was the only lepidopteran found in the study. On *E. dentata* I found pupae on a webbed and heavily damaged plant growing near the webworm's main host, the tree of heaven, *Ailanthus altissima* Swingle (Simaroubaceae). *Atteva* spp. are thought to be restricted to simaroubaceous plants (Duckworth, 1967), and for the ailanthus webworm I am aware of just one additional host, *Simarouba glauca* DC (Bawa and Opler, 1978).

In addition to the various species found breeding on *Euphorbia* there was a diverse group of insect visitors. I observed (but did not identify) ants foraging at the nectariferous glands associated with flowers (cyathia) and Diptera and Hymenoptera visiting flowers. Nymphs of the mirid *Spanagonicus albofasciatus* Reuter and the leafhopper *Xerophloea viridis* (F.) occurred under *E. maculata* but may have been breeding on nearby grasses. In North Carolina, however, the abundance of *X. viridis* nymphs under isolated mats suggested that this leafhopper feeds partly on spurges.

I found a disproportionately greater number of species associated with the prostrate *E. maculata* than with the erect *E. preslii*. Species richness of any *Euphorbia*-insect association appears influenced by growth habit of the host plants. Ehrenfeld (1979) found that mats of *E. albomarginata* attracted three times the number of pollinating species compared to the two erect *Euphorbia* spp. Parasitic insects are among the known flower visitors, e.g., the tachinid fly *Winthemia quadripustulata* (F.) on *E. nutans* (Allen, 1925). Topham and Beardsley (1975) regarded *Euphorbia* flowers as such

an important nectar source for parasites that they recommended maintaining spurges along margins of cultivated fields.

The insect community I found associated with *E. maculata* was dominated by sucking insects associated with inflorescences and fruits. Several of these sap feeders are restricted to spurges, whereas other, mainly little-studied, species were collected consistently from these plants. Considerable overlap was apparent between the Pennsylvania and North Carolina, and even Florida, spurge-insect communities. Few polyphagous or generalist species were present. Native spurges, although far from depauperate, harbored few chewing insects that might help limit populations of introduced, weedy spurges. Even so, the relatively specialized fauna should interest students of animal-plant coevolution.

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